RE-INDUSTRIALISATION – A COMMENTARY

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by

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Abstract
The share of manufacturing in UK employment and value-added at current prices ("value-added" for short) has fallen dramatically in recent years. This commentary investigates the feasibility of reversing this decline. The paper explores the implications of four scenarios over the next twenty-five years. These scenarios generate very different trajectories for the share of manufacturing in value-added. A stronger manufacturing sector would grow faster and generate more net exports. However, the share of manufacturing in employment or value-added would be unlikely to increase. Rapid labour-saving productivity growth in the manufacturing sector would limit the growth of employment in this sector despite rising output. It would also drive down the relative price of manufactured goods, thereby holding down the share of the fast growing manufacturing sector in value-added.

Keywords: De-industrialisation, re-industrialisation, output shares, employment shares.

JEL Codes: E66, F41, F47, O5

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Executive summary

The share of manufacturing in UK employment and value-added at current prices ("value-added" for short) has fallen dramatically in recent years. This commentary investigates the feasibility of reversing this decline. The main focus will be on the value-added share, but the conclusions apply to the employment share with equal force.

The paper begins by comparing the historical experience of the UK and a large group of European countries. It first documents how the share of manufacturing in value-added has fallen rapidly in both areas, but the decline has been fastest in the UK, especially after 1995. These changes in the value- added share are then decomposed into three components:

- shifts in the pattern of domestic expenditure,
- shifts in the net trade balance in manufactures,
- shifts in the relative price of manufactures as compared to other goods and services.

This is only a proximate decomposition since in practice these components are behaviourally inter-related. For example, a decline in the relative price of manufactured goods stimulates the demand for manufactures at the expense of other goods and services. Foreign trade influences relative prices both directly through the provision of cheaper goods and indirectly through impact of foreign competition on the productivity of local firms.

Comparing the UK with the rest of Europe over the past forty years, shifting expenditure patterns have had a similar impact on the manufacturing share in the two areas. Relative price movements were also very similar in the two areas. The main difference was the massive deterioration in the UK manufacturing trade balance from a surplus of +4.8% of GDP in 1970 to a deficit of -4.4% in 2010. Over the same period, Europe's manufacturing trade balance fluctuated considerably but had no clear trend. This difference in trade performance is the main proximate reason why the share of manufacturing in employment and value-added fell more rapidly in the UK than elsewhere in Europe.

Looking to the future, the paper explores the implications of four scenarios over the next twenty-five years. These scenarios generate very different trajectories for the share of manufacturing in value-added. At one extreme this share declines rapidly in line with past trends. At the other extreme the share is a bit higher in 2035 than it was in 2010. The first three scenarios make identical assumptions about the evolution of domestic expenditure and relative prices, assuming in each case that past trends continue. They differ only in their assumptions about trade performance in manufactures, with successive scenarios assuming stronger trade performance. The

final scenario assumes a slower shift in the composition of domestic demand away from manufactures and a slower decline in the relative price of manufactured goods than under the other scenarios, together with the biggest improvement in the trade balance.

It is only under the last scenario that there is an increase in the manufacturing share of value-added over time. To generate this modest "re-industrialisation" requires strong assumptions. Under this scenario, there is a slower decline in the relative price of manufactured goods than in the past. Since relative productivity and relative prices are closely correlated, this implies a *slower* rate of relative productivity growth in manufacturing than in the past. This scenario also assumes a very large turnaround in the trade balance in manufactures, from a deficit of -4.4% of GDP in 2010 to a surplus of +2.0% in 2035. Given the likely performance of other parts the balance of payments, notably financial services and other knowledge-intensive services, such a surplus in manufacturing trade might be neither economically desirable nor sustainable.

The third scenario appears more feasible, maintaining the historic trends in the domestic demand for manufactures and in their relative price, with a more modest improvement in trade performance, which merely eliminates the present deficit in manufacturing trade. Under this scenario, the value-added share of manufacturing still declines but at a much slower rate than in the past and by implication, the share of employment in manufacturing would also continue to fall. However, manufacturing output in real terms would grow significantly faster than GDP, and with a growing labour force, the absolute number of jobs in manufacturing might increase somewhat. In this limited sense, a "re-industrialisation", as compared with the past forty years, would seem feasible.

The main conclusions are as follows. A stronger manufacturing sector would grow faster and generate more net exports. However, the share of manufacturing in employment or value-added would be unlikely to increase. Rapid labour-saving productivity growth in the manufacturing sector would limit the growth of employment in this sector despite rising output. It would also drive down the relative price of manufactured goods, thereby holding down the share of the fast growing manufacturing sector in value-added.

1. Introduction

In the aftermath of the financial crisis it has been widely argued that the UK economy requires rebalancing, away from financial and related services, towards manufacturing industry. Having de-industrialised in recent decades, the UK needs to re-industrialise. The term "re-industrialisation" has various meanings, but it is most frequently taken to mean an increase in the share of manufacturing industry in value-added or employment. This paper accepts that the UK may need a stronger manufacturing sector, but it questions how far such an improvement in performance would be accompanied by an increase in the share of manufacturing in value-added or employment. The historical decline in this share would certainly be slowed down or even halted in the event of a successful rebalancing, but this decline is unlikely to be significantly reversed. The absolute number of people employed in manufacturing sector might increase by a modest amount, but this would be against the background of a stable or falling share of this sector in total employment.

It must be stressed that this is not a paper about policy. It has nothing to say about how to re-industrialise the economy or, more generally, how to strengthen the manufacturing sector. It is exclusively concerned with structural issues, in particular how a stronger manufacturing performance would affect the share of manufacturing in national value-added and, by implication, employment.

The paper contains two main sections, together with a technical appendix which describes in detail how the results discussed in the body of the paper are obtained. The first section compares the historical experience of the UK with that of a large group of other European countries ("Europe"). The share of manufacturing in value-added has fallen dramatically in both areas since 1970, but the decline has been greater in the UK than in Europe. After reviewing the proximate reasons for this difference, the paper concludes that the main proximate reason is the external trade performance of the UK manufacturing sector.

The next section presents some projections for the period 2010-2035. These projections cover a variety of possibilities and their outcomes range from a rapid decline to a modest increase in the share of manufacturing in value-added and, by implication, employment. Under only one, rather unrealistic, scenario does the manufacturing share actually increase and then by only a modest amount. Under a more realistic scenario, the share of manufacturing slowly declines. By implication there would also be a gradual decline in the employment share of manufacturing. However, because total employment in the economy is expected to grow, this falling share might be accompanied by some increase in the absolute number of people employed in manufacturing. As the paper concludes, this is about as close to "re-industrialisation" as one can reasonably expect.

2. Historical experience

The weight of a sector in the national economy is conventionally measured by its share of total employment or of current price value-added (value-added for short). In an advanced economy like ours these shares are similar and follow similar paths through time. This is what we should expect if profit mark-ups are reasonably stable over time and wages in the various sectors grow at approximately the same rate. We shall focus mainly on the behaviour of the value-added share, although our observations will apply with equal force to the employment share. As can be seen from Figure 1, the UK has experienced a dramatic fall in the share of manufacturing in both value-added and employment.

Figure 2 compares UK experience with what happened in an aggregate of European countries ("Europe") over the period 1970-2010[1]. The share of manufacturing in value-added was initially similar in the two areas and in both of them this share fell dramatically during ensuing decades. However, the decline was faster in the UK than Europe, especially after 1995. Cumulatively, the manufacturing share fell by 18.2 percentage points in the UK over the period as compared to 11.7 percentage points in Europe.

The share of manufacturing in current price value-added depends on both prices and quantities. This share may fall because the price of manufactured goods falls in relation to the average price of other goods and services. It may also fall because the output of manufactured goods grows more slowly (or falls more rapidly) than other types of output. The output of manufactured goods is arithmetically equal to domestic expenditure (including additions to inventories) on manufactures plus net exports (exports *minus* imports), so the behaviour of the manufacturing share depends on what happens to both of these items.

Figure 3 shows what happened to net manufactured exports in the UK and Europe over the period 1970-2010[2]. The net manufactured exports of Europe fluctuated considerably during this period, but as a fraction of GDP they were much the same in 2010 as in 1970. In the UK, in contrast, there was a huge fall in net exports, from +4.8% of GDP in 1970 to – 4.4% of GDP in 2010. Such a turn-around in the manufacturing trade balance represents a substantial reduction in the demand for UK manufactures and was an important factor behind the falling share of manufacturing in value-added.

Figure 1: Share of Manufacturing in Value-added and Employment
United Kingdom (percent)

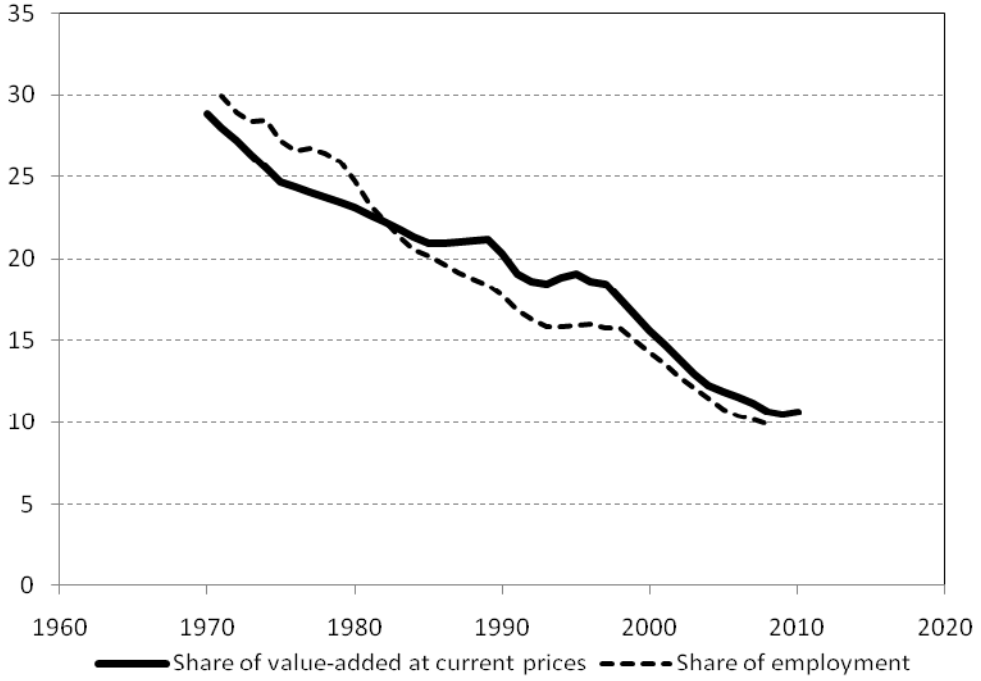


Figure 2: Share of Manufacturing in Value-Added
UK and Europe compared

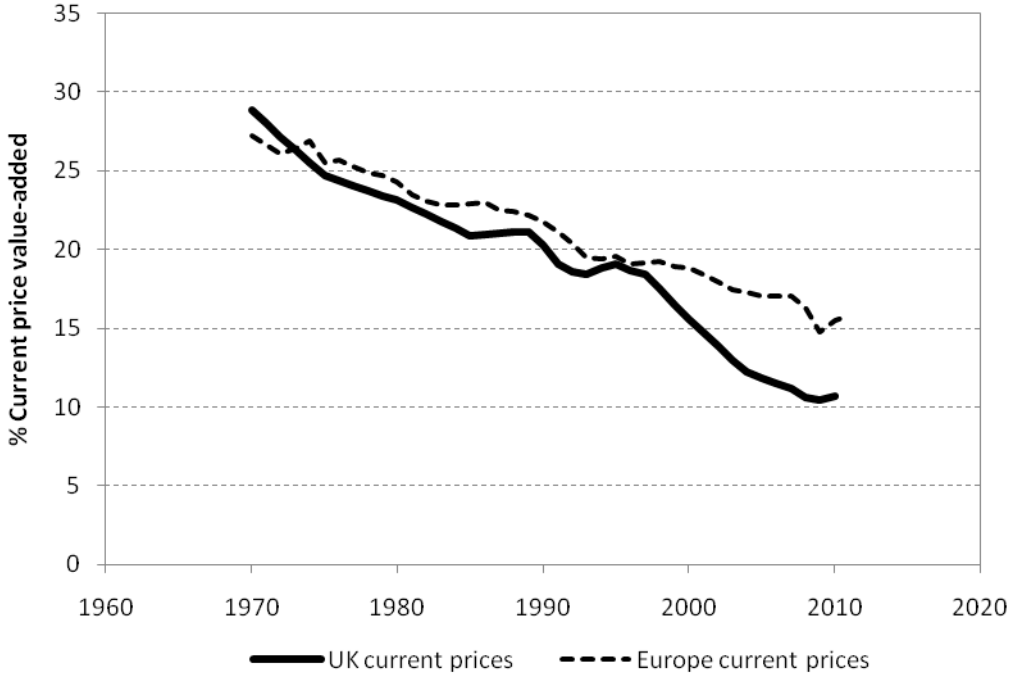


Figure 3: Manufacturing Trade Balance - UK and Europe Compared

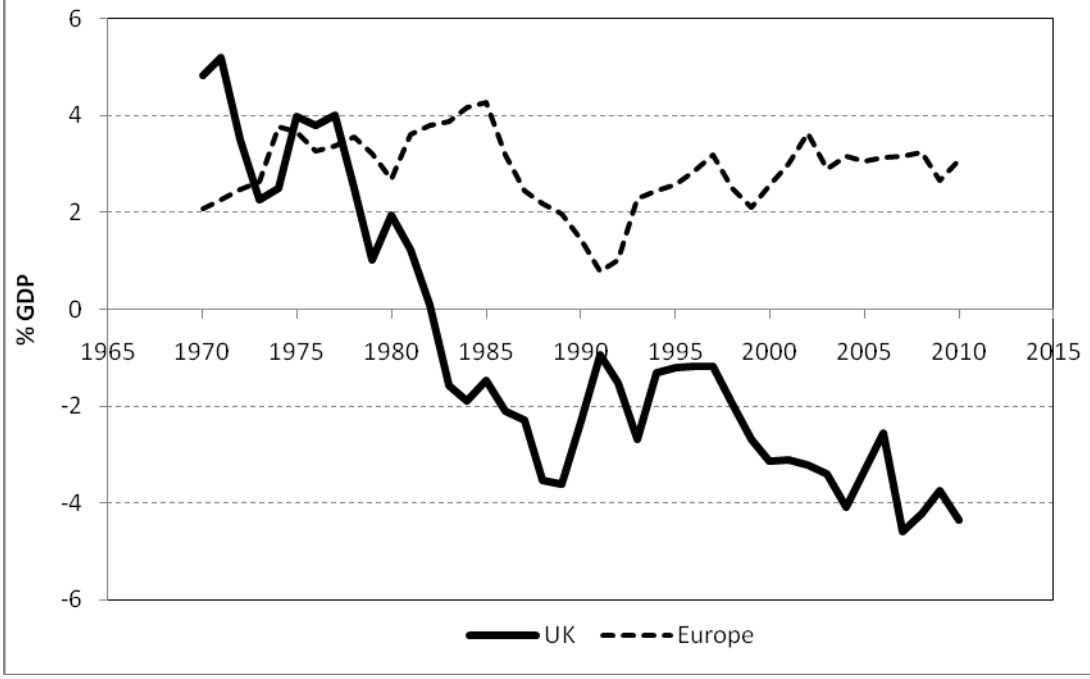


Figure 4: Relative Price of Manufactures - UK and Europe Compared
index 1970 = 1

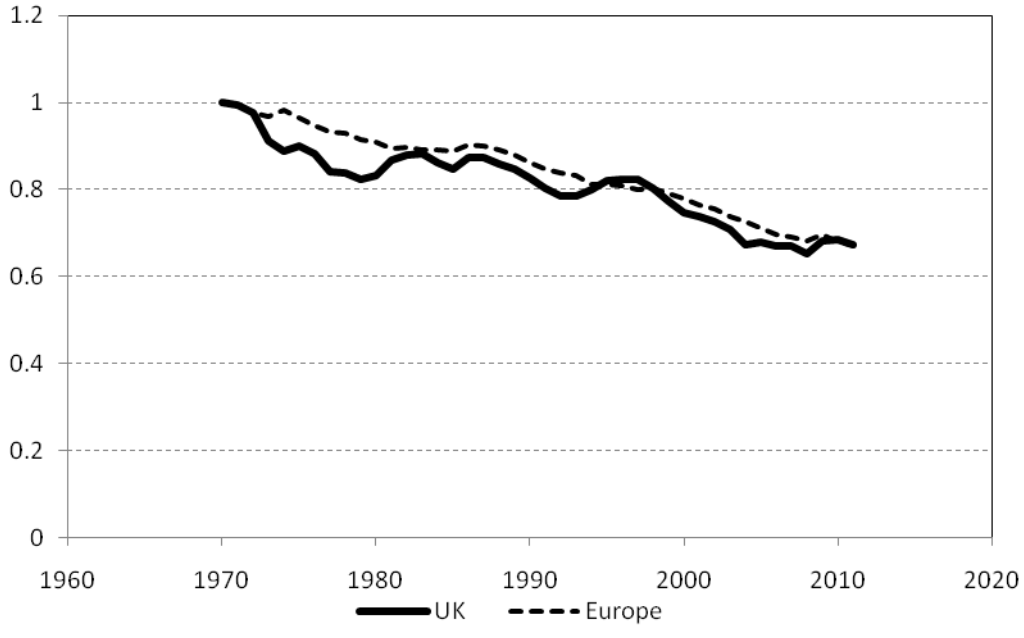


Figure 5: Adjustments to Manufacturing Share of Value-added
United Kingdom

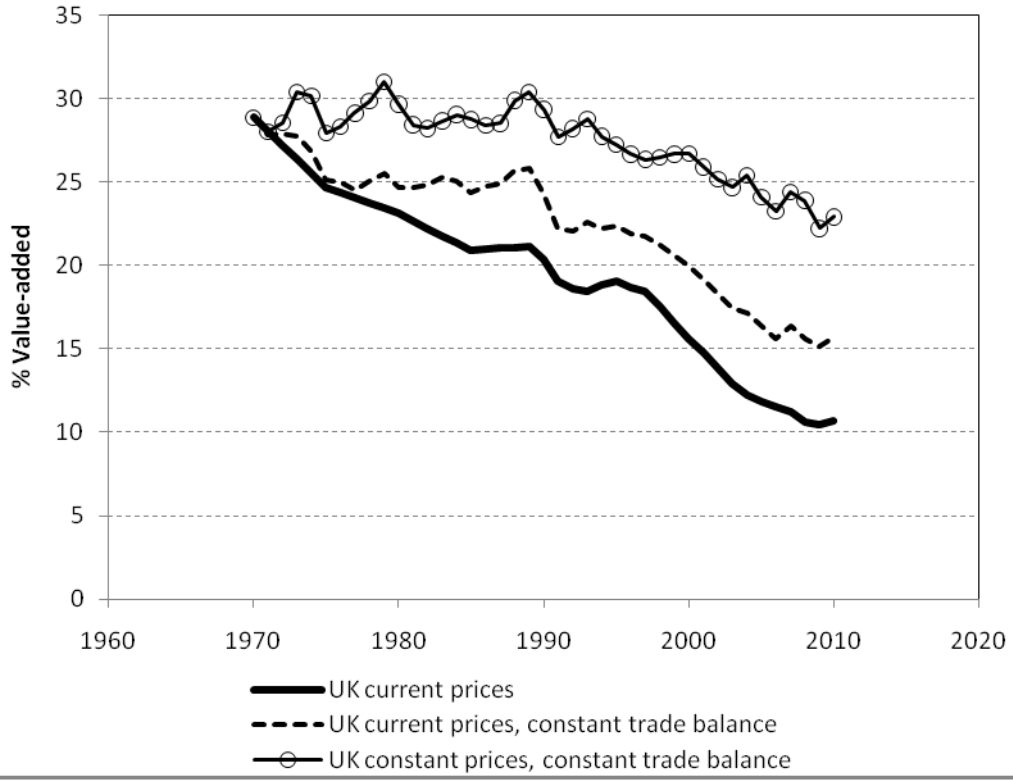


Figure 6: Adjustments to Manufacturing Share of Value-added
Europe

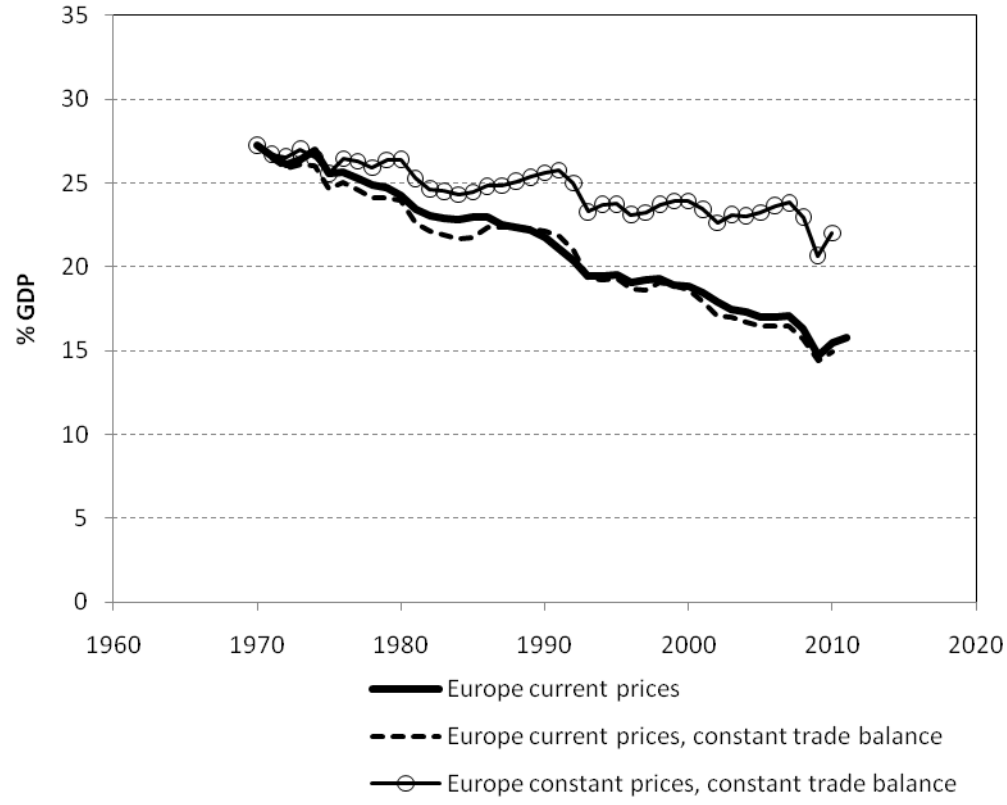


Figure 4 shows what happened to the relative price of manufactured goods (as compared to goods and services in general) over the period 1970-2010[3]. In both the UK and Europe, the cumulative fall over the period was around 33%, which represents an annual rate of decline equal to 0.94%. This downward trend was mainly due to the fact that productivity growth was on average faster in manufacturing than elsewhere in the economy.

Using information on trade and relative prices it is possible to quantify, at least proximately, the contribution of various factors to the observed de-industrialisation[4]. The following analysis decomposes changes in the manufacturing share of current price value-added into three components: (1) a trade balance effect, (2) a relative price effect, and (3) a demand effect which reflects changes in the composition of real domestic expenditure. It must be stressed that this is only a statistical decomposition and does not imply that the three effects are causally independent. For example, the composition of domestic expenditure depends on relative prices. If manufactured goods become relatively cheaper, this will encourage buyers to increase the relative quantity of manufactures they purchase as compared to other goods and services. Thus, the size of the demand effect in our decomposition will be influenced by the behaviour of relative prices. The behaviour of relative prices is in turn affected by a country's participation in foreign trade. Competition from imports may reduce the relative price of locally produced manufactures by inducing local firms to produce more efficiently. Moreover, the relative price of manufactured goods is highly correlated with relative productivity, so the price effect in our decomposition includes productivity effects of all kinds, including those that originate from international competition.

Coutts and Rowthorn (2013a) present several estimates of how trade impinges on internal economic structure. The most relevant estimate in the present context is derived from UK input-output tables[5]. This estimate implies that, other things being equal, a 1 percentage point fall in the ratio of net manufactured exports to GDP is associated with a reduction of approximately 0.55 percentage points in the share of manufacturing in value-added. We can use this coefficient to modify the observed trajectory of the UK manufacturing share so as to remove the direct structural impact of foreign trade. The result is shown by the dashed line in Figure 5. The equivalent result for Europe is shown in Figure 6. As expected, the trade balance adjustment has a large effect on the UK share but is of minor importance for Europe.

The next step is to modify this hypothetical trajectory to allow for relative price changes. This is done by dividing the hypothetical trajectory by the price index shown in figure 4. The resulting curve plots the "constant price, constant trade balance" share of manufacturing in value-added. This curve indicates how variations in the composition of domestic demand affect the share of manufacturing in the national economy. The downward slope of the curve shows how in real terms the

composition of domestic demand is shifting away from manufactures towards other goods and services.

Table 1. De-industrialisation Decomposed: UK and Europe 1970-2010

	UK	Europe	UK *minus* Europe
Share of manufacturing in current price value-added (%)			
1970	28.9	27.2	1.6
2010	10.7	15.5	-4.8
Change 1970-2010	-18.2	-11.7	-6.5
of which:			
Domestic demand	-5.9	-5.2	-0.7
Relative price	-7.2	-7.1	-0.1
Trade balance	-5.1	0.5	-6.6

Table 1 summarises the cumulative impact of the changes shown in Figures 5 and 6. Since 1970 the UK and Europe have experienced very similar shifts in the composition of domestic demand away from manufactured goods towards other items, mainly services. They have also experienced very similar reductions in the relative price of manufactured goods. Since growth rates of real income per capita and relative prices have been similar in the UK and Europe, this suggests that price and income elasticities of domestic demand for manufactures must be similar in the two areas. This issue is explored briefly in the technical appendix[6]. The main difference between the UK and Europe concerns the impact of foreign trade. The huge deterioration in the UK manufacturing trade balance over the period is the main proximate reason why de-industrialisation has occurred more rapidly here than in Europe. Even so, our poor trade performance accounts for well under a third of the observed decline in the share of manufacturing in UK current price value-added (and employment). This conclusion does not take into account the indirect impact of foreign trade on relative prices and productivity, which it beyond the scope of this paper to consider.

Table 2. Proportionate Contributions to Changes in the Share of Manufacturing in UK Current Price Value-Added (% p.a.)

	Actual 1970-2010	Projected 2010-2035 I SuperServ	Projected 2010-2035 II Serv	Projected 2010-2035 III Man	Projected 2010-2035 IV FastMan
Domestic demand	-0.58	-0.58	-0.58	-0.58	-0.40
Relative price	-0.94	-0.94	-0.94	-0.94	-0.60
Trade	-0.97	-0.97	0	1.15	1.41
Total	-2.49	-2.49	-1.52	-0.37	0.41

Table 3 Growth Rates of Real Output (% p.a.)

	Whole Economy	Manufacturing
Actual 1970-2008	2.49	0.98
Projected 2010-2035		
I SuperServ	2.50	1.05
II Serv	2.50	2.02
III Man	2.50	3.17
IV FastMan	2.50	3.61

3. Projections

In this section we present some projections for the period 2010-2035. These are not predictions of what will actually happen, but what would happen under certain assumptions about the future. Their purpose is to inform the contemporary debate about rebalancing of the UK economy towards manufacturing and to indicate its quantitative dimensions.

The assumptions underlying the various projections are shown in Table A4 of the appendix. These assumptions concern: (1) the rate at which the composition of domestic demand is shifting away from manufactured goods towards other goods and services, (2) the rate at which the relative price of manufactured goods is falling in comparison with other items, and (3) the behaviour of the manufacturing trade balance.

There are four scenarios: I (SuperServ), II (Serv), III (Man) and IV (FastMan). The name of each scenario is chosen to encapsulate some distinguishing feature. The first three scenarios make identical assumptions about the evolution of domestic demand and relative prices. In each case, domestic demand shifts away from manufactured goods towards services at the same annual average rate as in the past (1970-2010), and the relative price of manufactured goods also falls at the same rate as in the past. These scenarios differ only with respect to what they assume about the manufacturing trade balance. The final scenario assumes a slower shift in the composition of domestic demand and a slower decline in the relative price of manufactured goods than occur under the other scenarios. It also assumes a big improvement in the manufacturing trade balance.

Table 2 shows what the various projections imply for the share of manufacturing in value-added and for the balance of payments in 2035. The projected trajectories are illustrated in Figure 7. Table 3 shows what the projections imply for the growth rate of manufacturing output on the assumption that overall GDP increases by 2.5% p.a., which is the average rate observed over the period prior to the 2008 crisis.

The projected outcomes under the four scenarios are as follows:

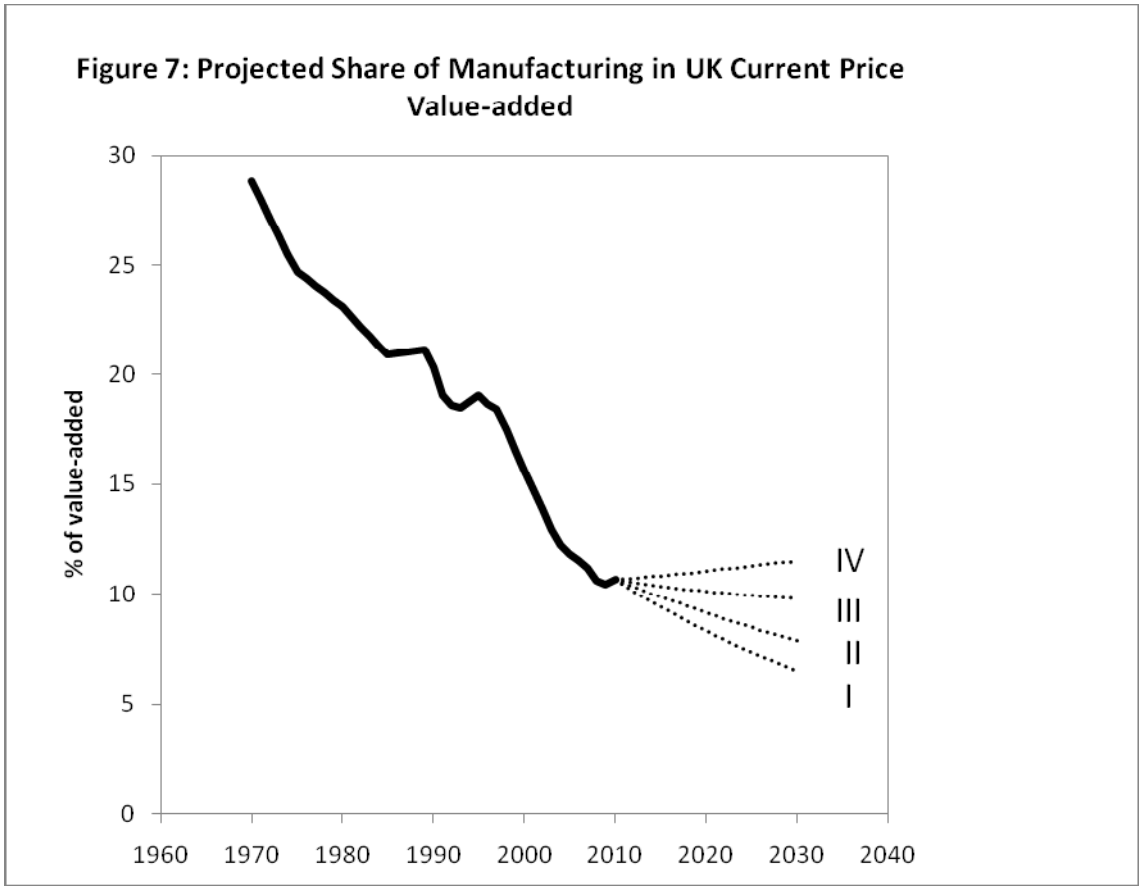
- *I (SuperServ)*: Under this scenario, manufacturing trade performance is very poor and by 2035 the manufacturing trade deficit reaches 7.3% of GDP. To sustain such a large manufacturing deficit would require massive improvements elsewhere in the balance of payments, above all in service exports: hence the name “SuperServ”. Under this scenario manufacturing output grows at 1.05 per cent a year, which is similar to the pre-crisis average. The share of manufacturing in value–added falls rapidly and by 2035 is down to 5.9%. The employment share would presumably fall by a similar amount. The absolute number of manufacturing jobs would also decline considerably.

- *II (Serv)*: Under this scenario the manufacturing trade deficit remains unchanged at 4.4% of GDP throughout the trajectory[7]. Since the economy starts off with a current account deficit and negative prospects for trade in energy (Coutts and Rowthorn 2013b), the achievement of external equilibrium under this scenario presumes an improvement elsewhere in the balance of payments, above all in service exports. The required improvement is not as large as under Scenario I, but it is still substantial: hence the name "Serv". Under this scenario manufacturing output grows at approximately 2 per cent a year, which is well above the pre-crisis average but slower than GDP. The share of manufacturing in value–added continues to falls and by 2035 reaches 7.3%. The employment share would presumably fall by a similar amount. The absolute number of manufacturing jobs would also decline although less sharply than under the previous scenario.

- *III (Man)*: Under this scenario, trade performance improves and the manufacturing trade deficit is eliminated by the end of the period. Such an improvement should be sufficient to eliminate the existing current account deficit and put the UK balance of payments on a sound footing. This scenario is named "Man" to stress the improvement in manufacturing trade performance. Under this scenario manufacturing output grows at almost 3.2 per cent a year, which is faster than GDP. However, because of falling relative prices, the share of manufacturing in value–added continues to fall, albeit slowly, and by 2035 is down to 9.7%. The employment share would presumably fall by a similar amount. However, because of growth in population and hence in the national labour force, the absolute number of manufacturing jobs would increase somewhat.

- *IV (FastMan)*: Manufacturing trade performance is much stronger under this scenario and by the end of the period there is a trade surplus equal to 2.0% of GDP. In addition there is slower shift in the composition of domestic demand and a slower decline in the relative price of manufactured goods than either historically or under the other scenarios. Under this scenario, manufacturing output grows at around 3.6 per cent a year, which is much faster than GDP: hence the name "FastMan". The share of manufacturing in current price value–added gradually rises to reach 11.8% by 2035. The employment share would presumably increase by a similar amount. Because of growth in the national labour force, the absolute number of manufacturing jobs would increase by a substantial amount.

- Of the above scenarios, IV(FastMan) is the only one under which there is an increase in the share of manufacturing in current price value-added. In the other scenarios, this share declines, sometimes by a considerable amount. The assumptions underlying FastMan are collectively rather extreme, although the resulting increase in the manufacturing share is modest. For example, the relative price of manufactures under this scenario falls at 0.6% p.a. which is quite a lot slower than the rate historically observed in most advanced economies. This assumption is also at odds with government policies seeking to encourage innovation in the manufacturing sector through the application of science and technology. To the extent they succeed, such policies will stimulate more rapid growth in productivity and thereby accelerate the decline in the relative price of manufactured goods.



Another questionable feature of FastMan is the assumption that the UK will enjoy a manufacturing trade surplus equal to 2.0% of GDP by 2035. Given the likely evolution of other items in the balance of payments, such as service exports, a manufacturing trade surplus on this scale would be un-necessary and perhaps unsustainable. If service exports continue to increase at a plausible rate in the future and there is some recovery in investment income, the UK will have no need for a large manufacturing trade surplus (see Coutts and Rowthorn 2013)[8]. Even if such a surplus could be achieved for a time, it might be difficult to sustain indefinitely. With a strong net export performance in both manufactures and services, sterling would

probably appreciate, causing UK producers in general to become less competitive and reducing net exports of all kinds. To this extent, an excessive manufacturing trade surplus would be self-correcting.

4. Conclusions

Under almost any plausible assumptions, the share of manufacturing in current price value-added (and employment) is likely to fall or at best stabilise. The one scenario under which there is an increase in this share rests on implausible assumptions about the behaviour of relative prices and the balance of payments. Even so, the eventual rise in the manufacturing share in current price value-added is modest.

A more plausible scenario is III (Man). Under this scenario, trade performance improves, the present manufacturing trade deficit is eliminated and the balance of payments is put on a sound footing. Manufacturing output grows faster in real terms than GDP, but because of rapid productivity growth, the relative price of manufactures falls rapidly and there is a gradual decline in the share of this sector in current price value-added. By implication there would also be a gradual decline in the employment share of manufacturing. However, because total employment in the economy is expected to grow, this falling share might be accompanied some increase in the absolute number of people employed in manufacturing. This is about as close to “re-industrialisation” as one can reasonably expect.

Notes

1 The European countries are as follows Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden and Switzerland. The data on GDP are from http://unstats.un.org/unsd/snaama/dnllist.asp . The relevant UN spread sheets are: "GDP and its breakdown at constant 2005 prices in US Dollars" and "GDP and its breakdown at current prices in US Dollars".

2 Data on manufacturing trade were kindly provided by the UN Statistics Division in Geneva. Our European total for net exports assumes that net exports between countries within the European group cancel out. This will be true if exports and imports are measured on the same statistical basis, since recorded exports from country A to country B will then be equal to recorded imports by country B from country A. In practice, there may be inconsistencies in the recording of exports and imports by different countries. However, such errors are unlikely to be very important in the present context. They are unlikely to alter the finding that net manufactured exports from Europe were much the same as a percentage of GDP in 2010 as in 1970.

3 Each price index shown in figure 4 was derived as follows. A price series for manufacturing was obtained by dividing the UN series for current price value-added by the UN series for constant price value- added. The same procedure was done for the economy as a whole. Dividing the former price index by the latter gave a series for the relative price of manufactures. The resulting series was rescaled to make the relative price equal to 1 in 1970.

4 See the technical appendix for a detailed description of the methods used for this quantification.

5 See the appendix for an explanation of this choice.

6 Relative prices and the composition of demand are, of course, intimately related. Without this sustained decline in relative prices, the composition of demand would have shifted away from manufactures even faster than actually occurred (see Rowthorn and Ramaswamy 1999).

7 Of the four scenarios considered in this paper, II (Serv) is closest to the base projection in Coutts and Rowthorn (2013b) which projects little change in the manufacturing balance as a percentage of GDP.

8 Ajit Singh (1977) defined a manufacturing sector as “efficient” if it earns a big enough surplus, at a socially acceptable exchange rate, to cover the deficit other kinds of trade. In the modern UK context, given the strong performance of service exports, efficiency does not require a large manufacturing trade surplus. It may be sufficient for the manufacturing sector to sector to avoid a large deficit.

9 Throughout this appendix shares are given to one decimal place. Because of rounding errors totals may not add.

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Technical appendix

This appendix describes the methods which underlie the various diagrams and tables presented in the text.

Let $p_i(t)$ and $v_i(t)$ denote the price and net output of good (or service) *i* at time *t*. The subscript *m* will be used to denote manufactures.

Shares in value-added

The share of manufacturing in current price value-added is:

$$S_{\cdot}(t) = \frac{p_m(t)v_m(t)}{\sum_i p_i(t)v_i(t)}$$

The UN database used for this paper also provides series based on 2005 prices. The share of manufacturing in constant price value-added is defined as follows:

$$\bar{S}(t) = \frac{p_m(2005)v_m(t)}{\sum_i p_i(2005)v_i(t)}$$

Relative prices

An implicit price index for total output is given by

$$P(t) = \frac{\sum_i p_i(t)v_i(t)}{\sum_i p_i(2005)v_i(t)}$$

Aggregate real output is given by

$$v(t) = \sum_i p_i(2005)v_i(t)$$

Note that

$$P(t)v(t) = \sum_i p_i(t)v_i(t)$$

The following is a price index for manufactures:

$$P_m(t) = \frac{p_m(t)}{p_m(2005)}$$

An index for the *relative* price of manufactures (as compared to goods and services in general) is given by:

$$r_m(t) = \frac{P_m(t)}{P(t)}$$

The above expression can be written as follows:

$$r_m(t) = \frac{S(t)}{\overline{S}(t)}$$

This index has the property that $r_m(2005) = 1$.

Define

$$R_{t_0}(t) = \frac{r_m(t)}{r_m(t_o)}$$

This is the relative price index for manufactures rescaled so that $R_{t_0}(t_0) = 1$.

Modifications

Consider a trajectory that begins in year t_o. The constant trade balance trajectory is defined as follows:

$$S^*_{t_0}(t) = S(t) - b\,[B(t) - B(t_0)]$$

where *B(t)* is the balance of trade in manufactures as a share of GDP and *b* is a constant. Throughout the text it is assumed that *b = 0.55* (see Coutts and Rowthorn 2013a, appendix Table A1). This new trajectory is the original trajectory modified so as to remove the structural impact of foreign trade on the composition of value-added.

The above trajectory can be modified as follows so as to remove the statistical effect of relative price changes:

$$S^{**}_{t_0}(t) = \frac{S^*_{t_0}(t)}{R_{t_0}(t)}$$

Table A1 uses the above definitions to decompose changes in the share of manufacturing in current price value-added over the period (t_0, t_1). It also shows how these changes affect the growth rate of the current price share.

Note that

$$S^{**}_{t_0}(t_0) = S^*_{t_0}(t_0) = S(t_0)\,.$$

hus, by construction all shares are equal at the start of the period. They diverge later under the influence of changes in trade and relative prices. Note also that there is no subscript for $S(t)$. This is an observed share which does not depend on the base year t_0. The quantities $S^{**}_{t_0}(t)$ and $S^*_{t_0}(t_0)$ require subscripts because they are normalised to equal $S(t)$ in the base year t_0.

Table A1: Basic Calculations for 1970-2010					
		1970	2010	Derivations	Exponential growth rate of share 1970-2010 (% p.a.)
(1)	Actual current price share *S(t)*	28.9	10.7	Observed	-2.49
(2)	Manufacturing trade balance *B(t)*	4.8	-4.4	Observed	
(3)	Current price, constant trade balance share $S^{*}_{1970}(t)$	28.9	15.7	$S^{*}_{1970}(1970) = S(1970) = 28.9$ $S^{*}_{1970}(2010)$ $= S(2010) - 0.55 \times [B(2010) - B(197$ $= 10.7 - 0.55 \times (-9.2)$ $= 15.7$	-1.52
(3)	Relative price index $R_{1970}(t)$	1.00	0.68	Observed	-0.94
(4)	Constant price, constant trade share $S^{**}_{1970}(t)$	28.9	22.9	$S^{**}_{1970}(1970) = S(1970) = 28.9$ $S^{**}_{1970}(2010)$ $= S^{*}_{1970}(2010) \div R_{1970}(t)$ $= 15.7 \div 0.68$ $= 22.9$	-0.58

Basic Calculations for 1970-2010

Table A1 shows the basic calculations for the period1970-2010. The actual current price share at the end of the period is $S(2010) = 10.7$. As a fraction of GDP, the manufacturing trade balance changes by $B(2010) - B(1970) = -9.2$ percentage points over the period. To remove the effect of this change on the share of manufacturing we

adjust the observed terminal share by -0.55 × (-9.2) percentage points. The adjusted share is then $S^{*}_{1970}(2010) = 10.7 - 0.55 \times (-9.2) = 15.7$ [9].

This is labelled the "current price, constant trade balance share" in the diagrams in the text. We then divide $S^{*}_{1970}(2010)$ by the relative price index to obtain the "real" share $S^{**}_{1970}(2010) = S^{*}_{1970}(2010) \div R_{1970}(2010) = 15.7 \div 0.68 = 22.9$. This is labelled the "constant price, constant trade balance share" in the diagrams in the text. Table A1 also shows the growth rates of each type of share and of the relative price index over the period 1970-2010.

Table A2: Decomposing changes in the share of manufacturing in current price value-added

		UK 1970-2010	Effect on the average growth rate of the current price share over the period (t_0, t_1)	UK 1970-2010
Initial current price share	$S(t_0) = S^{*}_{t_0}(t_0) = S^{**}_{t_0}(t_0)$	28.9		
Domestic demand effect	$S^{**}_{t_0}(t_1) - S(t_0)$	$22.9 - 28.9 = -5.9$	$\left(\ln S^{**}_{t_0}(t_1) - \ln S(t_0)\right) \div (t_1 - t_0)$	-0.58
Relative price effect	$S^{*}_{t_0}(t_1) - S^{**}_{t_0}(t_1)$	$15.7 - 22.9 = -7.2$	$\left(\ln S^{*}_{t_0}(t_1) - \ln S^{**}_{t_0}(t_1)\right) \div (t_1 - t_0)$	-0.94
Trade effect	$S(t_1) - S^{*}_{t_0}(t_1)$	$10.7 - 15.7 = -5.1$	$\left(\ln S(t_1) - \ln S^{*}_{t_0}(t_1)\right) \div (t_1 - t_0)$	-0.97
Total change	$S(t_1) - S(t_0)$	$10.7 - 28.9 = -18.2$	$\left(\ln S(t_1) - \ln S(t_0)\right) \div (t_1 - t_0)$	-2.49
Final current price share	$S(t_1)$	10.7		

Decomposing Changes in the Manufacturing Share

The contributions of domestic demand, relative prices and the trade balance can be calculated using the formulae given in Table A2. The table also shows the formulae

used to express these effects in growth rate terms. In addition the table includes a numerical example based on UK experience over the period 1970-2010. The data used for this example are from Table A1. Note that, in behavioural terms, the various effects shown in Table A2 are interdependent. For example, demand and price effects are interdependent, since the demand for manufactures is a function of their relative price (see Rowthorn and Ramaswamy, 1999). See also the note towards the end of this appendix.

Table A3: Projection III(Man) for 2010-2035

	2010	2035	Derivation of 2035 value	Exponential growth rate 2010 -2035 (% p.a.)
Initial current price share $S(2010)$	10.7			
Constant price, constant trade balance share $S^{**}_{2010}(t)$	10.7	9.2	$S^{**}_{2010}(2035)$ $= S^{**}_{2010}(2010)\times\exp(25\times(-0.58/100))$ $= 10.7\times\exp(25\times(-0.58/100))$ $= 9.2$	= - 0.58 (assumed)
Relative price index $R_{2010}(t)$	1.00	0.79	$R_{2010}(2035)$ $= R_{2010}(2010)\times\exp(25\times(-0.94/100))$ $= 1\times\exp(25\times(-0.94/100))$ $= 0.79$	= - 0.94 (assumed)
Current price, constant trade balance share $S^{*}_{2010}(t)$	10.7	7.3	$S^{*}_{2010}(2035)$ $= S^{**}_{2010}(2035)\times R_{1970}(2035)$ $= 9.2\times 0.79$ $= 7.3$	= -1.52 (implied)
Manufacturing trade balance $B(t)$	-4.4	0.0	Target	
Final current price share $S(2035)$		9.7	$S_{2010}(2035) =$ $S^{*}_{2010}(2035) + b(B(2035) - B(2010))$ $= 7.3 + 0.55\times 4.4$ $= 9.7$	= - 0.37 (implied)

Projection 2010-2035

Table A3 shows how Projection III (Man) is obtained. This is done in reverse order from the historical calculation shown in Table A1. The projection starts from the initial values $S^{**}_{2010}(2010) = S^{*}_{2010}(2010) = S(2010) = 10.7$. The initial value of the relative price index for manufactures is $R_{2010}(2010) = 1$. The share $S^{**}_{2010}(t)$ and the relative price index $R_{2010}(t)$ are assumed to grow at constant exponential rates -0.58% p.a. and -0.94 % p.a. respectively over the period 2010-2035. These are same rates as their equivalents grew on average over the preceding period 1970-2010. The terminal values that result from these assumed growth rates are $S^{**}_{2010}(2035) = 9.2$ and $R_{2010}(2035) = 0.79$. Multiplying by the former share by the relative price index for manufactures yields $S^{*}_{2010}(2035) = 9.2 \times 0.79 = 7.3$. The required improvement in the trade balance is 4.4 percentage points. Such an improvement implies an estimated increase of 0.55 × 4.4 = 2.4 percentage points in the share of manufactures in current price value-added. Thus, $S(2035) = 7.3 + 2.4 = 9.7$. This is the projected share of manufacturing in current price-value at the end of the period in 2035, after demand shifts, relative price changes and the required improvement in the manufacturing trade balance are all taken into account.

Table A4: Contributions to the average growth rate of the current price share						
	Formula for the period (t_0, t_1)	Actual UK 1970-2010	I (Super Serv) 2010-2035	II (Serv) 2010-2035	III (Man) 2010-2035	IV (Fast Man) 2010-2035
Domestic demand effect	$\left(\ln S^{**}_{t_0}(t_1) - \ln S(t_0)\right) \div (t_1 - t_0)$	-0.58	*-0.58*	*-0.58*	*-0.58*	*-0.40*
Relative price effect	$\left(\ln S^{*}_{t_0}(t_1) - \ln S^{**}_{t_0}(t_1)\right) \div (t_1 - t_0)$	-0.94	*-0.94*	*-0.94*	*-0.94*	*-0.60*
Trade effect	$\left(\ln S(t_1) - \ln S^{*}_{t_0}(t_1)\right) \div (t_1 - t_0)$	-0.97	*-0.97*	*0.00*	*1.15*	*1.41*
Total change	$\left(\ln S(t_1) - \ln S(t_0)\right) \div (t_1 - t_0)$	-2.49	-2.49	-1.52	-0.37	0.41

Table A4 presents the actual growth contributions for the UK over the period 1970-2010. As already pointed out, in this case the domestic demand effect (-0.58) is a residual obtained by subtracting estimated demand (-0.73) and price effects (-0.94)

from the known total (-2.49). Projections are obtained using assumed entries for the domestic demand and relative price effects. Assumed entries are shown in italics. For Projection I the entry for the trade effect is the same as for the historical period 1970-2010. For the other projections the trade effect ensures that the manufacturing trade balance achieves some target value in 2035. The final total for each projection is obtained by summation.

Growth Rates of Real Output

The average growth rate of real manufacturing output over the period (t_0, t_1) is as follows $g_{v_m} = g_v + \left(\frac{\left[\ln S(t_1) + \ln R_{t_0}(t_1)\right] - \left[\ln S(t_1) + \ln R_{t_0}(t_1)\right]}{t_1 - t_0} \right)$

where g_v is the growth rate of GDP. The expression in parentheses is the growth rate of the share of manufacturing in "real" value-added.

A Simple Model of Relative Shares in a Closed Economy

Consider a closed economy in which the price and income elasticities are constant. In such an economy there is no need to make an adjustment for foreign trade. Using the previous notation and the symbol $'g'$ to denote growth rates the demand function for manufactures is as follows.

$$v_m = A\left(\frac{P_m}{P}\right)^{-\alpha} v^{\beta}$$

Since there is no adjustment for foreign trade

$$S^{**} = \bar{S} = \frac{v_m}{v} = A\left(\frac{P_m}{P}\right)^{-\alpha} v^{\beta-1}$$

$$S^{*} = S = \frac{P_m v_m}{Pv} = A\left(\frac{P_m}{P}\right)^{1-\alpha} v^{\beta-1}$$

The above formulae indicate how, for a given value of v, a change in relative prices, as indicated by P_m / P will influence the shares S^* and S^{**}. Differentiating logarithmically yields the exponential growth rates

$$g_{S^{**}} = g_{\bar{S}} = -\alpha\left(g_{P_m} - g_P\right) - (1-\beta)g_v$$

$$g_S = g_{S^*} = (1-\alpha)\left(g_{P_m} - g_P\right) - (1-\beta)g_v$$

Suppose that $0<\alpha$, $0<\beta<1, g_v>0$ and $g_{P_m}-g_P<0$. In this case $-\alpha\left(g_{P_m}-g_P\right)>0$ and $(1-\beta)g_v>0$. If $(1-\beta)g_v>-\alpha\left(g_{P_m}-g_P\right)$ the share of manufactures in real output S^{**} will decline through the course of time. This is what happens in all of the cases considered in this paper.

Foreign Trade

Coutts and Rowthorn (2013a) present an econometric analysis of the factors which determine the employment share of manufacturing. Their analysis finds that imports from developing economies have a larger impact on the manufacturing share than do imports from advanced economies. An earlier paper by Rowthorn and Ramaswamy (1999) explored this issue in greater depth. The authors found that competition from low-wage economies leads to higher productivity in the importing economy by either driving out certain types of local production or encouraging local firms to producer more efficiently or move up market. They also found that such productivity effects are highly correlated with changes in relative prices within the importing country and that lower prices are the main channel through which imports from low-wage economies influence the composition of real expenditure. Their estimates imply that the labour saving effect of higher productivity outweighs the demand-enhancing effect of lower prices, so the net impact of the two effects on manufacturing employment is negative. This negative impact is measured by the coefficient for LDCIMP in their regression equations for the employment share of manufacturing in Rowthorn and Ramaswamy (1999, Table 4).and in Coutts and Rowthorn (2013a, Table 2). However, these equations do not include explicit terms for either prices or productivity. In contrast, our statistical decomposition contains a specific component for relative price changes. This component includes the impact of foreign trade of all kinds on relative prices, including indirect effects that arise from the impact of trade on productivity. Moreover, the influence of relative prices on the composition of real expenditure is included in our demand effect. Hence, the effects associated with LDCIMP in the regression analyses in the above articles are already captured by the relative price and expenditure effects in our decomposition. There is therefore no need to include an explicit developing country trade effect in the decomposition.

This leaves the straightforward compositional effect of foreign trade on the internal structure of the economy. Suppose that net exports of manufactured goods increase by 1 per cent of GDP and at the same time net exports of other items, such as services, fall by an equal amount. Other things being equal, this will cause the output of the manufacturing sector to rise and the output of other sectors to fall. The effect of this switch will be an increase in the share of manufacturing in value-added or employment. Its effect on the employment share is estimated by the coefficient of MANTRADEBAL in the regressions of Coutts and Rowthorn (2013a, Table 2). They

estimate that a 1 percentage point rise in the ratio of net manufactured exports to GDP will lead to a rise of 0.207 to 0.312 percentage points in the employment share of manufacturing. As the authors point out, these estimates are implausibly low. Calculations based upon the UK input-output tables for 2008 give a value for this coefficient in the range 0.42 to 0.52 for the employment share and 0.52 to 0.59 for the value-added share (Coutts and Rowthorn 2013a, Appendix Table A1). These are probably a better guide to the compositional impact of foreign trade than the regression coefficients. In our decomposition we therefore assume a value of 0.55 for the coefficient of MANTRADEBAL ('B' in our notation) in accordance with the input-output table. For practical reasons we assume the same coefficient for all years and for both Europe and the UK. We make no additional allowance for imports from developing countries, for reasons stated above. It should be borne in mind that the relative price effect in our decomposition includes relative price effects resulting from trade of all kinds.